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ABSTRACT

A rationale is presented for teaching gifted students to gain computer literacy, learn programing, use utility software (e.g., word processing packages), and use interactive educational courseware containing drills, simulations, or educational strategy games to develop higher level and creative thinking skills. Evaluation of courseware for gifted students is addressed briefly. (MC)

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TEACHING HIGHER LEVEL THINKING SKILLS THROUGH COMPUTER COURSEWARE

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While this presentation focuses on using computer courseware in gifted programs, a brief overview of the many possibilities for using computers with gifted students will serve as a framework for the examination of courseware for teaching higher level thinking skills.

COMPUTERS IN GIFTED EDUCATION

Computer Literacy

Vital for all students in preparing for tomorrow's technological society, computer literacy is especially important for gifted students, many of whom will be involved in making far-reaching decisions regarding technology and society. Gifted students need to explore what computers can and cannot do, how widely and deeply they affect our society, and what ethical questions surround their use.

Programming

Programming is an excellent activity for increasing cognitive and creative skills and, as such, is an appropriate component of many gifted programs. It is widely recognized that programming can promote logical, deductive thinking. It is, however, less commonly understood that programming also strengthens creative thinking skills and problem-solving abilities. Programming can, in fact, enable students to think about thinking. In order to design and code a program to perform a specific task, students must thoroughly understand the thought processes required to solve the problem.

There are a number of reasons for teaching programming, and these objectives influence the particular programming language taught. Programming as career preparation might focus on Pascal, which is prevalent in computer science departments. Programming as a problem solving tool for use in scientific courses should involve the widely available BASIC and Pascal. Programming as training and experience in logical, analytical processes might feature LOGO and Pascal, but could also use BASIC. Finally, programming as an outlet for creativity could begin with LOGO, then use either Pascal or BASIC.

However, requiring all gifted students to learn to program computers makes less sense than making them all learn to play the piano. Programming is a specialized activity that may not be appropriate for all students or even all gifted students. The need to program computers in order to use them is quickly diminishing as computers are increasingly designed to be more "user-friendly." This is not to downplay the value of teaching programming skills, but rather to prevent generalities such as equating a "gifted program" with a class in computer programming.

Utility Software

The effective use of utility software packages goes beyond the realm of computer literacy. Such software is beginning to have a significant impact on curriculum

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in our schools. For example, word processing packages are changing the way writing is taught. Word processors allow students to achieve success in the area of composition where they previously had difficulty because of slow or poor handwriting ability or their own demand for perfection in their work. Gifted students should be encouraged to use word processing systems to record their creative ideas, evaluations, and conclusions. Other utility programs include graphics routines to draw and color on the screen and music generation packages for composing and recording original music. Both provide vehicles for the creative talents of gifted students. Also valuable are the electronic spreadsheets, which encourage students to explore "what if . . ." in a variety of realistic economics and business situations and to see immediately the results of their experiments.

Courseware

Courseware or educational software involves students in an interactive learning environment. Courseware exists in a variety of forms and levels of quality. Obviously not all courseware is appropriate for gifted students any more than all printed text material is suitable for the gifted. We will here explore courseware that contributes to the strengthing of higher level thinking skills, such as analysis, synthesis, evaluation, creative thinking, critical thinking, and problem solving.

Generally speaking, courseware can be divided into categories, although overlapping among categories is inevitable, and the distinctions seem to be fading as courseware becomes more sophisticated. Nevertheless, categories can be useful in illustrating the variety of courseware activities:

A. Drill and Practice

provides practice, usually with feedback, on skills or information the student has previously encountered.

B. Tutorial

provides instruction in new concepts or skills; includes examples and often involves practice; best when highly interactive.

C. Simulation

models a real life situation (or an imaginary one), allowing students to make decisions and observe the results; may or may not have game features.

D. Problem-Solving Tool

facilitates the solving of a student-defined problem by retrieving, analyzing, or calculating with data appropriate to the problem.

E. Educational Game

requires the creation of strategies to choose moves that will lead to a successful completion of the game; may involve memory, analysis, evaluation, logical thinking, and flexible thinking.

Each of these categories of courseware can be used in several modes, that is by individual students or large or small groups. Simulations, problem-solving tools, and games in particular are most valuable in a group setting. The myth that computers in instruction require that students work independently, concentrating on their own monitor screens, denies the powerful effect of computer courseware in encouraging group interaction. Gifted students who are given opportunities to work together on projects involving computers can improve their interaction skills and strengthen vital peer relationships.

COURSEWARE FOR HIGHER LEVEL THINKING SKILLS

Drill and practice programs emphasize recall and comprehension, which are considered lower level thinking skills. Although most gifted students do not require extensive practice to learn concepts, computer drills can be useful in allowing a gifted student to master the material at an appropriately fast pace since the drills can be individualized. They might also be used in a content area in which a gifted student does not excel by providing unemotional, objective feedback for incorrect answers. The computer does not expect a gifted student to be gifted in all areas and will patiently correct student errors.

Tutorials are often designed to teach comprehension but can include analysis and evaluation as well. Some tutorials can be appropriate for gifted students because they adapt to individual students' abilities. These are highly interactive programs in which students control the pace of the instruction and which include extensive branching based on student responses to numerous questions. However many tutorials are still of the "page turner" variety, simply a textbook on a screen. These should be avoided.

It is in the other three courseware categories, simulations, problem-solving tools, and educational games, that higher level thinking skills are emphasized.

Simulations are probably the most exciting form of instructional computer programs now available and may become the dominant form of courseware. Simulating or modeling real world events is a process that computers perform expertly and that no other media can accomplish. By simplifying complex situations and permitting specified parameters to be altered, simulations enable students to experience processes and events. Students analyze data, evaluate possibilities, make decisions, observe the results of the decisions, and reevaluate the situation on the basis of the results. Simulations condense time, allowing the examination of events lasting too long for classroom study. They also permit students to experiment in safety without the possibility of disastrous results.

Three well-known MECC simulations involve this process and illustrate the variety of events which can be simulated. ODELL LAKE simulates the food chain among fish and other animals around a lake. OREGON simulates a trip by covered wagon along the Oregon Trail. LEMONADE simulates the business of managing a lemonade stand.

Problem-solving tools enable students to use the information retrieval and calculating power of the computer without writing their own programs. This courseware allows students to focus on setting up the problem, on the steps of a solution, and on interpreting and evaluating the results. The computer performs the necessary but tedious intermediate calculations. These tools can be valuable in teaching problem-solving heuristics in realistic problems.

Examples of this courseware include graphing programs in mathematics, food intake analysis and calorie expenditure analysis programs in nutrition, and numerical analysis and statistical programs in mathematics, the sciences, and the social sciences.

Educational strategy games require the development of successful strategies. Students learn to analyze the game situation and predict or imagine the results of various possible "moves". They evaluate the possible outcomes before choosing their moves, then reevaluate the situation after their moves and their opponents' moves. Creating strategies requires a great deal of "what if. . ." thinking.

Examples of educational strategy games include WORDS, a language arts memory game BAGELS, a logical thinking guessing game, and GERTRUDE'S PUZZLES, games involving attributes and sets. Educational games can be designed to encourage fluent thinking, such as the word game FRIENDLY FRED where players compete in generating words that meet stated rules.

EVALUATING COURSEWARE FOR GIFTED STUDENTS

Identifying courseware appropriate for gifted students can be a formidable task. Such courseware should meet three sets of criteria. It should be judged as instructional material, as material appropriate for gifted students, and as computer software.

First, courseware should be evaluated using the general criteria against which any educational material is measured. It must be instructionally sound, include identified learning objectives, have an appealing format, and be free of unacceptable social biases.

Then the courseware should be evaluated according to criteria used in selecting materials appropriate for gifted programs. These criteria include encouraging or requiring divergent thinking, problem finding and problem solving, and risk taking. Such materials should be adaptable to various learning styles and easily individualized. Extensive guides to evaluating curriculum materials for gifted programs, recently published in books and journals, can provide further guidelines.

Finally, the courseware should be evaluated according to criteria specific to computer-based materials. A highly recognized evaluation form for courseware is the one developed by MicroSIFT at the Northwest Regional Educational Laboratory in Oregon. In addition to the content of the courseware, these twenty-one criteria relate to the instructional quality and the technical quality of the software. Examples of specific criteria include appropriate use of graphics/color/sound, effective feedback, learner control of rate and sequence of presentation, ease of operation of the programs by students, and appropriate use of computer capabilities.

CONCLUSION

Computers are an important factor in the education of gifted students today and will grow in importance in the years ahead. Their versatility and their ability to open new areas for study and exploration are of great benefit to gifted students. Computer courseware, one of many ways to make use of computers in gifted programs, can be effective in strengthening higher level thinking skills. Some courseware appropriate for gifted students currently exists, and more will soon become available as the sophistication of courseware increases and as its potential for use with gifted students becomes more widely recognized.